
ENVIRONMENTAL Fact Sheet



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Residential Spring Well Design

The definition of a “spring” varies widely. Most authorities would describe a spring as similar to a dug well where the static (non pumped) water level rises above the top of the surrounding ground level. For this reason many spring features are similar to those for dug wells. Dug well construction is discussed in fact sheet DWGB-1-4 “Dug Well Design” at www.des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm (scroll to DWGB-1-4). For information concerning the proper abandonment of springs, see fact sheet DWGB-1-7 “Well Abandonment and Decommissioning.” It is normally not possible to stop the water flow from springs.

GOVERNMENT REGULATIONS

State Regulations: A person or firm in the business of constructing any type of well must be licensed by the NH Water Well Board. The Board requires the submission of a well completion report describing the spring’s design, construction, soil conditions encountered, and the yield.

There are **statewide** design criteria rules for all well **construction** and **placement**. These rules (We 602.03), which apply to springs, were originally adopted by the Board in 1983 and subsequently revised. The rules of the Water Well Board are numbered We 100-1000. There are no state requirements concerning minimum water **quality** or **quantity** from springs.

Finally **RSA 477:4-c** requires, when selling a home with an on-site water system, disclosure of the water system's location, malfunctions, date of installation, date of the most recent water test and whether or not the seller has experienced a problem such as an unsatisfactory water test.

Local Regulations: Some towns may have local permit requirements relative to the placement, construction, water quantity or quality for springs. Please contact your local health officer or code enforcement program for particulars.

EVALUATING A NEW WATER SYSTEM

There are several items to consider when planning a water system. These are described below.

Determining How Much Water You Use

A typical household requires approximately 5 gallons per minute (gpm) to meet modest domestic water needs. Factors to be considered when determining a family’s demand on a water system include the number of water uses, their flow rates, how many of these uses could occur simultaneously, and for what duration.

Determining How Much Source Yield You Need

What minimum spring yield will satisfy a family’s water needs is more difficult to determine. As little as 1-3 gpm of well yield could be tolerated if there is adequate water system storage. A low yield spring (i.e. 1-3 gpm) may be acceptable if one makes use of water stored in the spring casing above the outlet pipe to the home or in large basement storage tank(s). This storage may not be available when the water table drops or the natural overflow

ceases all together in the summer or fall. Storage below the outlet within the casing may allow installation of a pump if the duration of pumping will be short. The typical 2 ½ foot diameter concrete spring well tile has a storage volume of approximately 35 gallons per foot of **water** depth. Spring overflow capacity often varies substantially. The time to determine a spring's yield is late summer when the groundwater levels, and thus the spring's natural recharge, are at their lowest level for the year.

Large non-pressurized storage tanks installed in the basement can serve this same function of accumulating water during periods of non-use. However, a pump will be necessary to pressurize this stored water. Taste and odor caused by stagnant water during long storage also need to be considered.

NHDES has published a document entitled "Well Yield, How Much Water is Enough?" which is available for \$2.00 through the Water Well Board. The United States Department of Agriculture Farmers Home Administration Guidelines require a minimum well yield of 1,200 gallons for a four-hour period (an average rate of 5 gallons per minute) for home use.

Seasonal Changes in Well Yield

It should also be recognized that a spring's yield may change with time. This change can be a seasonal variation or long-term trend. Thus, one should try to develop the maximum spring capacity when the spring is first installed. Spring capacity generally can not be varied much by construction.

Springs can be thought of as a water source with spontaneous overflow above the ambient ground level. Spring flow can be subject to drought effects. The best time to construct a spring is in the late summer or early fall when low water tables facilitate construction. This will allow a deep spring while minimizing muddy conditions and excavation cave-in. The outlet pipe should be set as low as possible and also must be "laid to grade".

Water Quality Considerations

Spring wells experience few iron, manganese, and taste and odor conditions. Spring wells generally do not experience arsenic, fluoride and radiological problems that are seen in bedrock wells. Spring wells **often** experience bacteria problems caused by poor configuration, poor construction materials, vandalism, animal entry, and inadequate soil filtration.

Spring Placement and Protection

Since springs can take water from the highest water table in the soil, they can be extremely sensitive to those land use activities that take place in their immediate vicinity. It should also be noted, that for free flowing springs, the recharge area can be at a different location than the immediate area near the spring outlet point and also at a higher elevation. Potential spring sites located within 50 feet of surface water should not be developed unless the spring is uphill of the surface water.

Examples of chemical hazards to a spring include the application or inadvertent spillage of fertilizer, pesticides, and inappropriate disposal of crankcase oil, anti-freeze or solvents, or salt brine backwash from water softeners. Thus, the use of chemicals near-by or uphill may negatively affect the quality of the water in a spring.

Tests for many of these modern chemical contaminants involve complex and costly laboratory procedures. Thus the best and least costly approach to protecting the water quality of a spring is prevention of pollution rather than installation of treatment after the fact. Be careful with respect to the use and disposal of chemicals near and upstream of a spring.

The following protective distances are required or recommended when choosing a location for a spring water supply for a private single family home.

- a) Surface water and drainage culverts should not pass within 25 feet of a spring; 50 feet + is recommended.
- b) Animals should not be penned or tied within a minimum of 20 feet of a spring. DES recommends a 75 foot separation.

- c) Leach fields and septic tanks shall not be located within 75 feet of a spring.
- d) Springs should not be developed if they are within 50 feet of the right-of-way line of roads. An even greater distance is preferred.
- e) Springs shall not be developed if they are within 75 feet of adjacent property boundary (see RSA 485-A:30-b). If placement is made necessary within 75 feet, a standard release form is required to be signed by the spring owner and given to DES, the town health officer, and the county registry of deeds. Since most zoning codes require a 10 foot setback from adjoining property lines, this distance is effectively 65 feet. See fact sheet DWGB-21-4 “Best Management Practices for Well Drilling Operations” at www.des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm (scroll to DWGB-21-4).
- f) A spring should not be developed in locations subject to ANY flooding unless the immediate 25 foot radius of the spring is built up above the highest flood level possible.

Springs on Other Properties

Many springs are located on property adjacent to that of the user's. At best, the user's right to the spring is based on an easement that gives very little detail. Such easements are often thought to be deficient in the following areas.

- a) Lack of restriction of hazardous activity uphill or otherwise near the spring.
- b) Lack of sufficient room or approval for maintenance around the spring or connecting piping.
- c) Approval or access to spring or delivery piping.
- d) Comments on the amount of water allowed to be taken.

DES recommends that these shortcomings be corrected now while the party, or relatives of the person that granted the easement are available or more inclined to give greater detail of the rights of the user.

Choosing the Water Supply Type You Will Purchase

Based on the considerations above, such as soil depth, water needs, and existing pollution, etc., a well type can now be chosen. In many cases there is relatively little choice since the choice of well types is largely influenced by the type of soil and the water availability on the property. As previously stated, this fact sheet pertains to spring type wells.

Contracting With a Spring Well Contractor

After determining that a spring location is viable, a contractor will need to be selected. The contractor will need guidance as to what concept will govern the amount of work to be done in developing the spring. Normally, spring wells are installed on a lump sum contract basis. The nature of the contract is between the homeowner and the spring well contractor. DES suggests that the finished configuration, dimensions, and finished elevation of the top and bottom of the spring be discussed in advanced before work begins.

CONSTRUCTION OF NEW SPRINGS

In choosing which spring location to develop, it is important to ensure that the spring has year round flow capacity. If the spring goes dry during the summer, this location should be either by-passed, or the location should be developed as a dug well with a pump. See the dug well fact sheet DWGB-1-4 “Dug Well Design” at www.des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm (scroll to DWGB-1-4), and refer to this document for information relative to addressing the seasonal overflow condition.

Excavation and Backfill

When beginning excavation, place different soil types in different piles so that they may be replaced in the same sequences as removed. Upper soil layers may be high in bacteria, organic material and readily soluble iron and manganese. If these poor quality soils are placed below the water table during backfilling, water quality problems may occur.

Try to prevent an accumulation of fine silt in the bottom of the excavation. An accumulation of silt may form an impervious layer reducing the entry of water into the completed excavation. When placing the crushed stone base

and spring well casing, break-up this fine sediment layer. At least 5 feet of soil backfill should cover the highest level of crushed stone, if crushed stone is used.

Depth

In dug wells, one usually excavates as deep as possible in order to have the spring well as resistant to drought affects as possible. In spring wells the excavation depth would be governed by the direction and origin of the upswelling water. The water conveyance line to the home should have at least 5 feet of cover to prevent freezing in snowless winters.

Stone Bed

A 1 foot \pm layer of 1-2 inch \pm crushed stone is often used at the bottom of a spring. This allows convenient leveling of the spring well tile. Where such stone is used, place multiple layers of progressively graded pea stone (course to small at top) above the larger crushed stone to act as a transition zone. This will prevent the backfill soil from settling into the crushed stone in the future. DES does not recommend the use of straw, tar paper or other degradable materials on top of crush stone as they may potentially cause bacteria and taste problems and also disintegrate with time. Many springs do not use crushed stone.

Pipe or Concrete Tile Sections

Pipe sections should be joined by bell and spigot or tongue and groove connections. This is critical since frost heaves or pressure from uphill soil, on a sloped site, will often displace tiles that are not locked into one another. If pipe sections can slide sideways, soil will fall into the spring casing. This in turn will cause settlement of the exterior backfill soils leading eventually to settlement of the backfill which in turn creates direct pathways for bacteria to enter the spring water table. Joints should be oriented as shown in the diagram (i.e. outside tongue facing down). Water should enter the spring at the bottom of the well casing. Wire reinforced concrete is suggested for spring well casing rings and the top cover. The joints between the highest two well casings should be cement mortared or otherwise sealed to achieve a water tight condition at the joint.

Casing Joint Sealing Material

Sealing the top two joints in concrete well casings, along with the space between the under side of the cover and the top of the casing will help to insure that all water in the well has been filtered thru soil. The material used for this seal should be appropriate for contact with potable water. Sealing is critical at only the top few joints. Those at bottom would not have bacteria present due to soil filtration. The product purity testing procedure is specified by the American National Standard Institute ANSI 61 standard. A sealant meeting this test procedure can be seen at www.conseal.com/products/CS-665.html. Other similar products will be listed as brought to our attention. No product endorsement is implied.

Apron

To insure proper infiltration of surface water entering the spring structure, an impervious apron of hardpan or fine silt soils should be placed on the top of the mounded backfill entirely around the spring. This apron should be approximately 10 feet wide or as wide as the excavation that was made to install the spring. The apron should be approximately 4 inches or more in thickness and sloped away from the well by 2 inches per foot. A greater slope should be considered if substantial settlement of the backfill is expected. Finally, the apron should be loamed and seeded to assure a stable condition. Without sloped backfill, puddles of contaminated water will form in contact with the spring casing and potentially leak into the spring. This condition often results in bacterial contamination.

Cover

A center observation hole in the cover is **not** recommended. If one exists on an existing spring, it should be sealed tightly and permanently to prevent the leakage of bacterially contaminated water into the spring from above. If the observation hole is subsequently opened, the seal must be remade. Acceptable substances for sealing the observation hole include cement mortar and that listed above. The cover should overhang the well and should ideally have a rain drip on the underside to prevent the leakage of contamination, from the top of the cover, into the spring on the underside of the cover.

The cover shape shown in the diagram is not regularly available in New Hampshire. However, DES urges concrete precasters to adopt this shape in order to solve the “underside” leakage problem. The underside of the cover may not be totally flat. It is suggested that reference marks be placed on both the cover and the casing to ensure the same alignment each time the cover is replaced. Cement mortar or sealants can then be placed on the vertical sidewall to match cover irregularities on the underside. This filler material however, tends to break off.

Another approach to minimize the space between the underside of the cover and the top of the casing is to grind or chip the top edge of the vertical casing to achieve a more precise fit with the under side of the cover. Drag a pencil along the underside of the cover so that it indicates the amount of grinding that needs to be done on the top edge of the casing. Use a rotary saw or abrasive wheel and breathing protection. DES suggests that the cover overhang the casing by at least 3 inches. This may help keep the soils next to the well casing dry which in turn may reduce the incidents of frost heaving (lifting) of the top casing.

If there is a need for an inspection port in the cover we recommend the fabrication of a second lightweight, easily removable shield to fit over the entire concrete cover. This shield should be lockable to prevent vandalism and could be made from welded steel, aluminum, or sheet metal. Plastic sheeting will deteriorate in sunlight and thus is not recommended. This rain shield can be locked in place onto the side of the concrete cover.

Overflow Pipe

Springs typically have an enormous range in flow from the highest in the spring to the lowest in the early fall. If the outlet pipe is of insufficient size the casing can be lifted out of position, and the excess flow will “punch out” beneath the casing at peak condition. To gauge the extreme of flow, DES recommends that the spring be “observed” during the snow melt season before the design and sizing of the spring construction components are determined. DES recommends that the design of the spring include all the flow capacity and that the overflow pipe have capacity to then release all water captured. If excess flow is not accommodated within the casing, it will rise out of the ground loosening the soil and destroying the filtration that prevents bacterial occurrence.

Excess flow will have such volume as to flow continuously. As a result excess water must have an escape pathway to exit from the interior of the spring well casing. This pipe is called an “overflow” pipe and is shown in the sketch. Key components of good overflow pipe design include.

- Resistant to vandalism.
- Have the elevation of the spring casing sufficiently high to achieve an approximate 1 foot “free fall” of the excess water from the overflow pipe to the ground.
- Have 1/2 inch or less hardware wire screen at the end of the overflow pipe covered by typical household mosquito screening to prevent entry of animal or insects back into the spring.
- Place stones “riprap” below the overflow spill point to prevent soil erosion.

A spring’s overflow pipe is typically identified as the cause of most bacterial contamination. Typical problems include.

- The reverse flow of contaminated surface water back into the spring.
- The use of the overflow pipe by small animals as a nesting area or walkway.

The high end of the overflow pipe is typically placed approximately 12 inches or more down from the top edge of the spring casing. The free fall discharge point should be approximately three or more feet away from the spring casing. The overflow pipe should slope away from the spring. Use an appropriate sized single piece of steel pipe supported at the outer end.

Water Supply Line to the Home

Provide at least 1 foot of clearance between the beginning of the pipe and the bottom of the spring. Provide a minimum of 5 feet of cover over the water line to the home for frost protection. Before backfilling, first take field measurements and then draw an accurate sketch of the precise route of the water line from the spring to your home. Duplicate this sketch, laminate and attach one copy of this sketch to your pressure tank or inlet pipe. It is

suggested that the pipe from the spring to the home be plastic. Seal this line as it passes through the foundation to reduce radon entry into the home. For old springs ensure that this piping is not made of lead. Where there is any doubt of the spring's year round flow of the outlet line to the home, the line should be installed as deep as possible at the spring and sloped continuously down hill.

AFTER CONSTRUCTION ACTIVITIES

Determining the Spring's Safe Yield

You should know the spring's safe yield. Once the spring construction is completed, a flow measurement test can be performed. The safe yield of a newly completed spring can be determined (and the spring flushed) by allowing water to run continuously over a sustained period at both the home and excess water coming out of the overflow pipe. Measure all flows using a 20 or 32 gallon trash can. This evaluation should be done in the late summer. If this water is initially muddy immediately after construction or reconstruction, do not run the water through the home's plumbing. For older springs, if the water is muddy after every rain storm (or any time, for that matter), inspect the spring construction immediately. A rapid change in the visual quality of the water is a clear sign that **the spring construction is not safe.**

Conduct at least an annual maintenance inspection of the spring. Remove leaves, repair aging materials, and replace damage cause by vandalism.

Disinfection - Chlorination

It is more difficult to disinfect spring since the upswelling water will resist percolation of the chlorine into the well. For new springs, it is most important to flush the spring of silt, mud, and debris before chlorinating or testing for bacteria. The spring may have to be allowed to flow continuously for days (or weeks, in a few cases) before this cleaning process is complete. Chlorine, regardless of its concentration, is NOT able to reach bacteria trapped inside accumulations of mud. DES strongly advises that a bacterial test NOT be taken until the spring has been thoroughly flushed.

The spring can be disinfected by adding liquid chlorine. One gallon of 5.25 percent sodium hypochlorite (i.e., common store bleach, such as Clorox) in 1,000 gallons of water will provide a good disinfecting solution of 50 parts per million (ppm). The quantity of water inside the spring well casing is shown below.

Volume in Wells (Gallons)

Water Depth (feet)	Well Casing Diameter (feet)			
	1	2	3	4
2.5	15	60	130	230
5	30	120	260	460
10	60	240	520	930
20	120	470	1060	1880

The volume of water inside the spring casing does not include the volume of water readily available in the crushed stone that normally surrounds the base of the spring casing. As a rough rule of thumb, DES suggests doubling the calculated volume inside the casing.

The procedure outlined below should be followed when disinfecting a spring. Add the chlorine directly to the spring plus an extra amount for the water in the crushed stone beyond the casing. Run each faucet in the home until a chlorine smell is detectable. Close the faucets and allow the chlorine to stay in the conveyance piping and

the plumbing 12-24 hours. If the spring is flowing, much of the chlorine will naturally wash out through the overflow pipe. After 12-24 hours, flush chlorine from the plumbing system. Do not flush into a septic system. Flush the chlorinated water onto the ground but not into a stream or pond, as chlorine will injure the environment. See fact sheet DWGB-4-11 “Disinfecting a Private Well” at www.des.nh.gov/organization/commissioner/pip/-factsheets/dwgb/index.htm (scroll to DWGB-4-11) for more information on disinfection.

Testing New Springs for Water Quality

After ALL chlorine is flushed from the spring and plumbing system, a sample can be taken for bacterial and chemical quality. Remember, all chlorine must be flushed from the spring. Water quality samples with any chlorine residual can NOT be tested for bacteria or nitrate/nitrite. The presence of chlorine can be checked by using a chlorine test kit. Such test kits are available from swimming pool supply stores or neighbors with pools.

For persons wishing to use the DES laboratory, the Legislature has established a \$15 fee for a bacterial test and an \$85 fee for the standard analysis test. Only agency sampling containers can be used. The time to process the standard samples is approximately three weeks during the summer and two weeks otherwise. Different containers are required for sampling radon gas, industrial solvents and hydrogen sulfide odor.

Sampling containers can be obtained from the Laboratory Services Unit. See the brochure “Water Quality Testing for Private Wells” at

www.des.nh.gov/organization/divisions/water/dwgb/well_testing/documents/well_testing.pdf for a discussion of which water quality factors to test for in a private spring. We recommend that a bacteria sample be taken on an annual basis for springs in view of their shallow construction and nonprecise building materials.

INSPECTING EXISTING SPRINGS

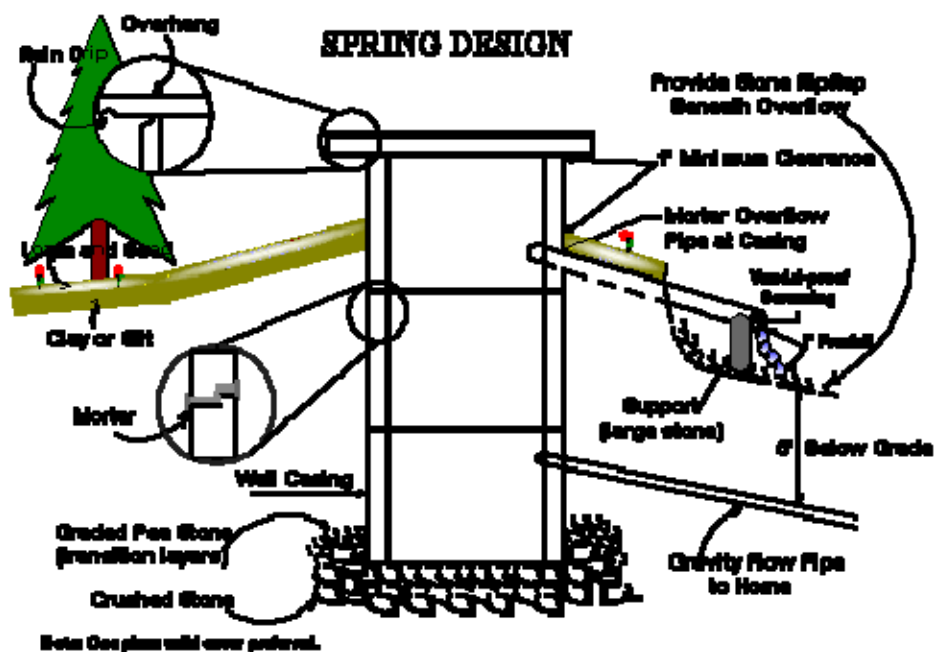
When inspecting an existing spring, look for any defects or openings in the casing which will allow foreign substances or small animals to enter into the spring. Also look for points where surface run-off can enter inside the spring casing directly from above.

Existing springs, especially those built of field-stone, are frequently subject to surface run-off, carrying bacteria and virus into the spring. To prevent this problem, all joints between the field stone should be mortared and the entire outside surface of the spring should be uniformly coated with cement mortar and wire mesh to provide a smooth, one piece exterior surface. This should extend down below the ground surface to the extent that conditions permit. Where concrete or vitrified clay tile is used, the top two joints between pipe sections should be sealed if possible.

Typically in older wells, the backfill around the well casing has settled. Once structural improvements to the casing are completed the backfill soil should be mounded up around the outside of the spring as shown. This backfill soil should be fine grained soils.

Wood covers are another common deficiency of older springs in that they are susceptible to rotting. Further, dirty rain water and debris can fall between the wood slats and into the spring. We recommend a solid one-piece concrete cover. The cover should extend beyond the well casing. The backfill next to the spring casing should be mounded. To achieve reliable bacterial quality, the spring construction MUST exclude ALL dust, dirt, surface water, and animals. If the spring construction is not tight and if there is not effective filtration of every drop of water entering the spring, the spring is NOT a safe water supply source.

The overflow pipe of most springs can be a major passage way for bacteria. Typical problems include the reverse flow of contaminated surface water back into the spring, or use of the overflow pipe as a walkway for small animals such as mice and chipmunks. This pipe must be screened and have a free fall at the end of the pipe to the ground below.



FOR MORE INFORMATION

Please contact the Drinking Water and Groundwater Bureau and the New Hampshire Water Well Board at (603) 271-2513 or dwgbinfo@des.state.nh.us or visit our website at www.des.nh.gov/organization/divisions/water/-dwgb/index.htm. All of the bureau's fact sheets are on-line at www.des.nh.gov/organization/commissioner/-pip/factsheets/dwgb/index.htm.

Note: This fact sheet is accurate as of October 2008. Statutory or regulatory changes, or the availability of additional information after this date may render this information inaccurate or incomplete."